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Strawberries for Ice Cream Manufacture

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AGRICULTURAL EXPERIMENT STATION
IOWA STATE COLLEGE OF AGRICULTURE AND
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CONCLUSIONS

1. Cold packed strawberries are superior to canned strawberries for flavoring ice cream, and both are far superior to strawberry extracts.

2. Strawberry extract is the cheapest source of flavor; berries cold packed by the plant operator are next lowest in cost, while the cost of preserved berries is the highest.

3. Strawberries frozen with sugar at -20° F. were superior in flavor to those frozen without sugar.

4. Strawberries packed at the ratio of 2 or 3 pounds of berries to each pound of sugar when frozen at -20° F. keep very well at the ordinary fruit room temperature of 15 to 25° F.

5. Storage temperatures higher than 25° F. are objectionable as they make sugar concentrations necessary that are undesirable in mixes which are fairly high in sugar.

6. Strawberries picked when ripe give a flavor to ice cream which is superior to that from strawberries picked for shipment.

7. Late season strawberries are slightly superior to early season strawberries for flavor in ice cream.

8. Variety differences are important from the standpoint of good strawberry flavor in ice cream.

9. Gandy, Kellogg's Prize, Early Jersey Giant and Dunlap appear to be the best Iowa varieties for flavoring ice cream.

10. Certain varieties of strawberries which are lacking in flavor give an inferior product regardless of the amounts used in the ice cream.

Strawberries for Ice Cream Manufacture

By N. E. FABRICIUS

The increasing demand for food products flavored with true fruits and fruit juices is of special interest to the ice cream manufacturer. Many cold packed fruits are available on the market although in numerous cases fruits are sold as cold packed which are actually preserved by the addition of various preservatives such as sodium benzoate.

In this circular fruits that are kept frozen, either with or without sugar, are considered to be cold packed, but fruits containing preservatives are classed as canned fruits. True cold packed fruits are expensive while the so-called cold packed fruits that contain a preservative are somewhat cheaper. As a result of this price difference a great deal of preserved fruit is used. It has been observed that the consumption of strawberry ice cream is materially decreased as soon as the strawberry season ends, and this is possibly due to the use of preserved fruit rather than the fresh full flavored strawberries.

A survey of 530 plants, made by the Bureau of Service and Statistics for the National Association of Ice Cream Manufacturers, showed that the consumption of chocolate ice cream was 10.06 percent of the total ice cream consumed, while strawberry ice cream represented 7.82 percent. In three Iowa plants where fresh strawberries were cold packed by the plant operators the average sale of strawberry ice cream was 9.6 percent of the total as compared with 7.5 percent for the chocolate flavored product. This seems to indicate that if fresh and true cold packed strawberries were used it would greatly increase the consumption of ice cream of this flavor.

SCOPE OF THE INVESTIGATION

As little information is available to the ice cream maker on the selection of varieties and the proper utilization and storage of fresh strawberries, the work reported in this circular was undertaken. The following points are considered:

(a) Strawberry ice cream made with strawberry flavor or extract as compared to ice cream made from the fruit.

(b) Ice cream made from canned or preserved strawberries as compared to that from strawberries cold packed with or without sugar.

(c) Ice cream manufactured from strawberries packed for shipment and strawberries packed when fully ripe.

(d) Ice cream made from early season, middle season and late season strawberries.

(e) A comparison of the flavor of ice creams made from 18 varieties of Iowa grown strawberries.

(f) Strawberries with different proportions of sugar stored at various temperatures.

PREVIOUS STUDIES

Horticultural workers recommend a variety of strawberry to the grower on the basis of its adaptability to a particular locality. Their statements in regard to the flavor of the strawberry may not be of use to the ice cream manufacturer, for different flavor characteristics of the variety have not been studied when used in ice cream. Mack and Fellers¹ found that some varieties of strawberries were lacking in flavor. They also found that the addition of vanilla extract to strawberry ice cream did not warrant the added expense. They report that the use of strawberry extract was not advisable.

Some work has been reported on the methods of cold packing fruit for ice cream. Mack and Fellers¹ report that strawberries packed at the ratio of 2 or 3 pounds of strawberries to 1 pound of sugar gave satisfactory keeping quality when held at 10 to 15° F. Similar results were secured by Turnbow and Cruess² and by Overholser and Cruess.³ These investigators used various containers, including lacquered tin cans, paraffined barrels and glazed earthenware crocks, all of which were found to be satisfactory. Culpepper, Caldwell and Wright⁴ found that in the case of peaches No. 10 cans⁵ were most satisfactory for storage because they permitted more rapid freezing of the fruit.

HOW THE TESTS WERE MADE

Sweet cream of uniform quality, whole raw milk and high quality dry skim milk were used in all the mixes of the tests reported in this circular. Cream, milk and milk powder were selected to give as uniform a mix flavor as possible. The mix composition used was 14 percent butterfat, 15 percent sugar,

¹Mack, M. J., and Fellers, C. R. Frozen fruit for ice cream. *Ice Cream Trade Journal*, Vol. 25, 8:59-62. 1929.

²Turnbow, G. D., and Cruess, W. V. *Calif. Agr. Exp. Sta., Bul. 434.* 1927.

³Overholser, C. L., and Cruess, W. V. Keeping fruit for ice cream fresh by freezing. *Ice Cream Trade Journal*, Vol. 20, 5:5-7. 1924.

⁴Culpepper, C. W., Caldwell, J. S., and Wright, R. C. Preservation of peaches for use in the manufacture of ice cream. *U. S. Dept. Agr., Tech. Bul. 34.* 1923.

⁵A no. 5 can has a volume of 197 cubic inches and is approximately four-fifths of a gallon.

9.7 percent milk solids not fat and 0.3 percent of high grade gelatin. The mix was pasteurized at 150° F. for 30 minutes and 2,500 pounds pressure with a single stage homogenizer of 100 gallons per hour capacity. The mix was cooled to 60° F. over a tubular cooler and then on down to 34° F. in vertical brine cooled holding tanks. The ice cream was frozen in a 40-quart Creamery Package brine freezer, Ft. Atkinson Model, with a brine temperature of —4 to —10° F. The strawberries were added to the mix in the freezer just before the brine was shut off. This gave the berries time to become properly distributed before the ice cream was drawn. All the ice cream was drawn at 80 percent overrun.

The strawberries for this work were obtained from the Horticultural Department of Iowa State College. Each variety was delivered the same day it was picked. The strawberries were immediately stemmed and most of them were packed with sugar at the ratio of 2 pounds of strawberries to 1 pound of sugar. They were put in paper cans, tin cans and glazed earthenware crocks of varying sizes and were frozen at —20° F. After being frozen they were stored until used in the fruit room which varied in temperature from 15 to 25° F. Some of the strawberries were packed in 1-gallon earthenware containers at the ratio of 1, 2, 3 or 4 pounds of strawberries to each pound of sugar. These containers were stored at 40°, 25°, 15°, and —10° F. Some lots were also held at these temperatures without sugar. Strawberries were also packed in sugar sirups containing 25, 35 and 50 percent sugar. Enough sirup was used to give 2 pounds of sugar for each 4 pounds of berries which was the amount put into each gallon container and was the quantity used for each 45-pound batch of mix.

In the comparison of flavors produced by different varieties and in a number of the other comparisons the strawberries were not held for more than two to three days before they were used in the ice cream. All the strawberries were placed at room temperature the night before they were to be used and were melted ready for use the following day.

When four or six different varieties were compared as to flavor produced in ice cream, these batches of ice cream were all frozen from one lot of mix. The ice cream was held two or three days before it was judged. All the samples of ice cream were placed by a group of 24 to 32 instructors and graduate students in the Home Economics Division.

DISCUSSION OF EXPERIMENTS

In general, people in the ice cream industry consider that pure fruits and pure fruit juices are superior to synthetic and concentrated extracts for flavoring ice cream. Before starting

the work on strawberries an effort was made to find out how much better the consumer really likes the ice cream flavored with the fruit. Two mixes were made and from each mix, three 45-pound batches of ice cream were frozen, one containing a strawberry extract in the amount recommended by its manufacturer, one containing a No. 10 tin of canned strawberries and the other containing 4 pounds of cold packed berries mixed with 2 pounds of sugar. The strawberry extract selected for this trial was highly advertised and supposed to be a good product. The canned berries were of the so-called cold packed type that contains a preservative which in this case was sodium benzoate.

These two runs were judged separately by 24 Home Economics instructors and graduate students. The numbers of first, second and third places received by each product in the two runs are recorded in table I. The first places were multiplied by three, the second places by two and third places by one, and the sums of these products were placed in the third column in terms of points. As the judges were from various parts of the United States and were naturally accustomed to a variety of ice cream flavors, their preference as to flavor should be somewhat representative of the general consumers' conception of a desirable strawberry flavor.

TABLE I

	No. of times placed first	No. of times placed second	No. of times placed third	Points
Strawberry flavor	0	8	40	56
Canned strawberries	10	32	6	100
Cold packed strawberries	38	8	2	132

None of the persons judging the samples placed the strawberry extract ice cream first. On a point basis the ice cream made from the canned strawberries was far superior to the ice cream made with the strawberry extract, while the ice cream made from the cold packed strawberries was placed much higher than either the ice cream made with the extract or the canned strawberries.

At the price paid for the strawberry flavor used in these studies, the cost of flavor per gallon of ice cream was 4 cents. The recommended amount gave to the ice cream a flavor of sufficient intensity, but it was distinctly lacking in the fine natural characteristic strawberry flavor. Many of the judges remarked that the flavor resembled raspberry as much as strawberry. Most of these extracts impart a characteristic tallowy taste.

The cost of flavoring ice cream with canned strawberries, which are often sold as cold packed but which contain preservative material, was from about 15 to 17 cents per gallon of ice cream in the amounts necessary to give the desired degree of flavor. While as much as 1 gallon was usually necessary for each 45-pound batch, yet even with this amount the product was criticized as lacking flavor.

The cost of the fresh strawberries cold packed for this experiment, including the cost of the berries, labor, refrigeration, sugar and cost of the container, amounted to 79 cents per gallon of fruit. This brought the cost of flavoring a gallon of ice cream to 7.9 cents. This figure includes a labor cost of 20 cents which is based on the actual time it took to stem, wash and pack the berries. Labor was figured at 40 cents per hour. The cost of the container was 10 cents and the sugar 12 cents. The refrigeration cost was estimated to be 7 cents. The average price paid for the berries was 7.5 cents per pound, bringing the cost of the 4 pounds to 30 cents.

From each of four mixes three batches of ice cream were frozen using the canned strawberries and the cold packed strawberries which had been frozen with and without sugar. These were again judged in the same manner as previously described. The strawberries cold packed with sugar showed up much better than those cold packed without sugar and the ice creams made from either were much more popular than the ice cream from the canned berries, as is shown in table II. The strawberries cold packed with sugar had a much brighter color and a more natural appearance than those cold packed without sugar. The criticism of the ice cream made from the strawberries cold packed without sugar was that they lacked flavor. The canned berries were always criticized as lacking fresh strawberry flavor.

TABLE II

	No. of times placed first	No. of times placed second	No. of times placed third	Points
Canned strawberries	8	28	60	148
Cold packed without sugar	12	68	16	188
Cold packed with sugar	76	0	20	248

Strawberries packed with equal weights of sugar when previously frozen at -20° F. later kept fairly well at 40° F. The strawberries when packed with 1, 2, 3 or 4 pounds of berries to 1 pound of sugar when held at 40° F. after freezing at -20° F. became slightly sour. The objection to packing at the ratio of 1 pound of strawberries to each pound of sugar is that the sugar concentration is so high that it becomes necessary to

modify the basic mix if the manufacturer désires approximately 15 percent sugar in the finished ice cream.

The strawberries packed at the ratio of 2 to 3 pounds of fruit to each pound of sugar after the preliminary freezing at -20° F. kept very well at 25° F. and all lower temperatures. When 2 or 3 pounds of berries were used to each pound of sugar the resulting product was very satisfactory when first frozen at -20° F. and later held at the ordinary fruit room temperature of 25° F. Strawberries packed at all ratios used when held at approximately -5° F. showed no advantages over the same ratios held at 25° F.

The strawberries without sugar did not keep well above 10° F. and even those held at very low temperatures were inferior in flavor as is indicated by the results in table II. No great difference could be noticed between the berries packed dry and those packed in a sirup. Tin, paper and earthenware crocks were all found to be satisfactory for the storage of strawberries. The paper container gave the berries a very slight paper taste, but this type has the advantage of being cheap. The tin and earthenware containers had no effect on the flavor of the strawberries.

A comparison was made between batches of ice cream frozen from Louisiana, Arkansas and Iowa strawberries. The Louisiana and Arkansas berries had been picked for shipment. The results, according to table III, indicate that the strawberries picked when ripe impart a decidedly better flavor to the ice cream. Variety differences, however, may also have been a factor here for the Louisiana berry was the Aroma variety, the Arkansas berry was the Klondike variety and the Iowa strawberry used was the Dunlap.

TABLE III

	No. of times placed first	No. of times placed second	No. of times placed third	Points
Louisiana strawberry	2	12	9	31
Arkansas strawberry	5	11	8	45
Iowa strawberry	17	0	7	58

A comparison was made of locally grown early season, middle season and late season strawberries and the results are presented in table IV. The Dunlap variety was used in this comparison. These berries were all cold packed and the last of the season strawberries were also held cold packed for two weeks before the ice cream for this trial was frozen. The results indicate that the late season strawberries show a slight advantage over the early season fruit.

TABLE IV

	No. of times placed first	No. of times placed second	No. of times placed third	Points
Early in season	6	10	6	44
Middle of season	6	12	4	46
Last of season	10	0	12	52

Table V shows the results of comparisons made on 18 Iowa varieties of strawberries. Four batches of ice cream were frozen from each mix with a different variety as the source of flavor in each batch. Eighteen runs were made and from these an effort was made to pick the varieties possessing outstanding merit. Kellogg's Prize shows up favorably in the first run. It also shows up well in classes 4, 15 and 17. Gandy is outstanding in classes 2, 14, 15 and 17. The Dr. Burrell variety shows up well in classes 5 and 6 and only fair in 1 to 18. Other berries selected for a final comparison were the Dunlap, Rewastico and Early Jersey Giant. As very few berries of the Early Jersey Giant variety were available it was tried only once in the preliminary runs and then in the final comparison.

These comparisons divide the 18 varieties into three classes: those of outstanding quality, Dr. Burrell, Dunlap, Gandy, Early Jersey Giant, Rewastico and Kellogg's Prize; those of medium quality, Mastodon, Premier, Kellogg's Delicious, Progressive, Parson's Beauty, Magic Gem and Corsican; and those of inferior quality for ice cream, Gibson, Kellogg's Marvel, Hendersen, Sample and Aroma.

The best six varieties were compared as to the flavor they produce in ice cream, and the results are presented in table VI. This comparison indicates that of these six there are four of outstanding quality: Gandy, Kellogg's Prize, Early Jersey Giant and Dunlap. This result checks well with placings given these berries in the data presented in table V.

In the last two tables it is apparent that there probably are great differences in flavoring quality in the varieties of strawberries. The criticism most often advanced for the least preferred sample was that it lacked flavor. In the case of two particular varieties the criticism was that they produced a flavor in ice cream which seemed artificial. Gibson, Kellogg's, Marvel, Hendersen and Sample, were commonly criticized as decidedly lacking in flavor, and were usually placed very low. Kellogg's Delicious, Corsican and Parson's Beauty were also criticized in some of the runs as lacking in flavor. The Aroma berry was commonly criticized as producing an artificial flavor in ice cream.

This makes it apparent that a careful selection of the variety producing the best flavor in ice cream is of importance. It is

also interesting to note that the varieties commonly picked for shipment such as Aroma, Gibson and Sample are inferior on the basis of the flavor produced in ice cream. The possible explanation of this may lie in the fact that strawberries to be shipped are picked somewhat green and also that the coarse grained varieties are selected for shipment because their appearance has more influence upon the buyer than their flavor.

TABLE V

CLASS 1					
Variety	No. of times placed first	No. of times placed second	No. of times placed third	No. of times placed fourth	Points
Premier	5	10	3	8	64
Dr. Burrell	8	3	8	7	64
Mastodon	3	8	9	6	60
Kellogg's Prize	10	5	6	5	72
CLASS 2					
Gandy	15	4	4	3	83
Kellogg's Delicious	6	4	10	6	62
Progressive	5	7	9	5	64
Sample	0	11	3	12	51
CLASS 3					
Aroma	5	4	4	8	48
Mastodon	4	8	7	2	56
Progressive	8	6	3	4	60
Parson's Beauty	4	3	7	7	46
CLASS 4					
Kellogg's Prize	16	6	1	0	84
Gibson	1	5	3	14	39
Magic Gem	4	9	9	1	62
Corsican	2	3	10	8	45
CLASS 5					
Gibson	3	3	9	16	55
Corsican	7	11	10	4	85
Dr. Burrell	17	12	2	0	112
Parson's Beauty	4	5	10	12	63
CLASS 6					
Kellogg's Marvel	3	6	3	16	52
Rewastico	7	11	6	4	77
Dr. Burrell	15	7	5	1	92
Parson's Beauty	2	4	14	7	55
CLASS 7					
Premier	9	10	5	2	78
Dunlap	12	9	5	0	85
Hendersen	3	3	7	13	48
Mastodon	2	4	9	11	49
CLASS 8					
Gibson	2	2	11	13	49
Corsican	4	10	6	8	66
Progressive	10	7	5	6	77
Kellogg's Delicious	12	9	6	1	80

TABLE V. (Continued)

CLASS 9					
	No. of times placed first	No. of times placed second	No. of times placed third	No. of times placed fourth	Points
Premier	7	6	5	3	59
Sample	1	3	2	15	32
Dunlap	9	1	11	0	61
Rewastico	4	11	3	3	58
CLASS 10					
Aroma	0	1	3	13	19
Corsican	4	3	6	2	39
Dunlap	5	5	5	0	45
Dr. Burrell	6	5	1	3	44
CLASS 11					
Parson's Beauty	2	1	5	9	36
Dunlap	7	6	4	0	54
Premier	2	6	7	2	42
Corsican	6	4	1	6	44
CLASS 12					
Parson's Beauty	10	8	5	3	77
Kellogg's Delicious	5	4	7	10	56
Rewastico	9	10	2	5	81
Kellogg's Marvel	2	4	12	8	52
CLASS 13					
Kellogg's Marvel	4	2	1	25	49
Kellogg's Delicious	5	7	15	5	76
Rewastico	10	15	7	0	99
Kellogg's Prize	13	8	9	2	96
CLASS 14					
Mastodon	5	8	8	5	65
Gandy	13	7	5	1	83
Magic Gem	6	8	7	5	67
Henderson	2	3	6	15	44
CLASS 15					
Gandy	13	8	6	2	90
Magic Gem	2	10	12	5	67
Gibson	1	2	7	19	43
Kellogg's Prize	13	9	4	3	81
CLASS 16					
Dunlap	4	11	4	5	62
Early Jersey Giant	19	4	1	0	90
Premier	1	4	12	7	47
Gibson	0	5	7	12	41
CLASS 17					
Magic Gem	10	5	9	4	77
Gandy	5	12	8	3	85
Gibson	2	4	4	18	46
Kellogg's Prize	11	7	7	3	82
CLASS 18					
Dunlap	15	9	0		63
Dr. Burrell	4	7	13		49
Magic Gem	4	8	11		43

TABLE VI

Variety	No. of times placed first	No. of times placed second	No. of times placed third	No. of times placed fourth	No. of times placed fifth	No. of times placed sixth	Points
Dr. Burrell	0	4	0	2	4	14	48
Gandy	4	7	11	2	0	0	109
Kellogg's Prize	8	2	6	6	1	1	103
Rewastico	1	0	1	4	25	3	45
Early Jersey Giant	5	7	5	3	1	3	99
Dunlap	5	4	1	7	3	4	85

The fact that the Sample strawberry was lacking in flavor in early runs suggested the idea of increasing the amount used in order to overcome the lack of flavor. Six pounds of this variety were used in 45 pounds of mix in class 9, table V, without any apparent improvement in its rating. This same scheme was tried with the Gibson in class 5, table V, and in class 8, table V, with only a very slight improvement in its rating. This indicates that economical flavoring with cold packed strawberries depends to some extent on the selection of the proper variety.